Space Weather Technical Forecast

Issued on Tuesday, 17 October 2023 at 01:14 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of G1/Minor Storm intervals on Day 1-2 (17-18 Oct).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Low, with occasional C-flares. Peak flare was C9.8 from a new sunspot region rotating onto the northeast limb. The largest spots are AR3464 and AR3465, which are both relatively mature spots in the northwest and near centre disc respectively, and showed very little development. The other regions are all smaller and simple to give a total of six regions. A long period C7.5 also occurred from ex-AR3467 in the northeast, which subsequently decayed. This produced a CME, with analysis still ongoing. However preliminary assessment suggests either missing or a slight glance possible early day 4 (20 Oct).

Solar Wind / Geomagnetic Activity: Solar winds, as measured by ACE were indicative of background slow wind. Solar winds speeds erratically eased from 380 km/s to around 330 km/s. Density was below or around average. Interplanetary magnetic field (IMF), Bt, was weak at below 4nT. The north-south component, Bt, was also weak varying -2nT to +3nT, but mainly positive (northward). Phi angle was main negative (towards the Sun). Geomagnetic activity was Quiet (Kp 0-2).

Energetic Particles / Solar Radiation: GOES16 high energy (greater than 10MeV) proton flux was at Background. GOES16 high energy (greater than 2MeV) electron flux was at Background throughout. Associated 24-hour fluence was well below the Active (1e8 integrated pfu) threshold. The observation at 17/0000UTC was 1.56e6 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Low activity is expected, with only slight chance of isolated M-flares.

Solar Wind / Geomagnetic Activity: Two CMEs are forecast to give a glancing impact early on 18 Oct, perhaps as a single combined arrival. The first is from a corona-based dimming near N35W030 starting around 14/0340UTC. The second from a CME observed due to a filament lift north of AR3466 at 14/1240UTC, around N15W025. Otherwise the onset of CH60/+ fast winds is expected day 1 (17 Oct), later and likely weaker than originally anticipated, but still giving a potential for winds to increase to around 450-500km/s. These winds, along with any CME influence, then ease later day 2 (19 Oct) with background slow wind conditions following. Mainly Quiet geomagnetic forecast activity at first, but Unsettled to Active spells likely with a chance G1 Minor Storm intervals day 1 and 2 (17-18 Oct). Activity easing back to mainly Quiet day 3 and 4 (19-20 Oct).

Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux will most likely remain at Background levels. High energy electron flux (greater than 2MeV) is expected to rise late in the period in response to any enhancements that occur on day 1 and 2 (17 and 18 Oct), reaching Moderate, perhaps peaking High. The associated 24 hour fluence is expected to rise day 3 and day 4, but with only a slight chance of reaching Active (1e8 integrated pfu).

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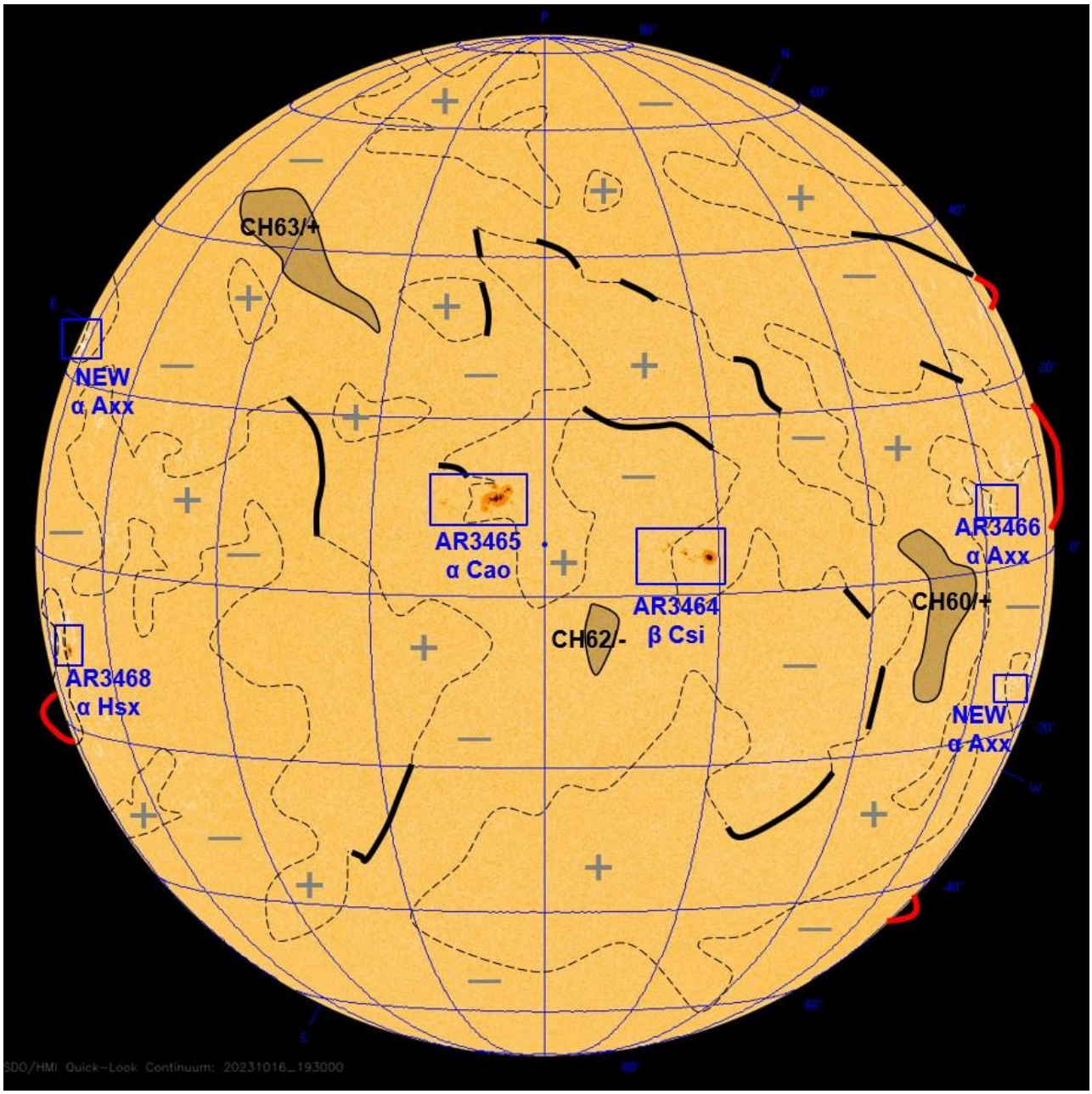
Figure 1. Solar Analysis Valid 16/2000 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

There are two CMEs with potential Earth-directed components. The first is from a corona-based dimming near N35W030 starting around 14/0340UTC. The second from a CME observed due to a filament lift north of AR3466 at 14/1240UTC, around N15W025. Given similar speeds and source longitude and one shortly following the other, these CMEs have the potential to follow each other closely, or more likely occur as a single glance. This is currently forecast for early day 2 (18 Oct). A further CME which was observed from the C7.5 of AR3467 on 16 Oct in the northeast. Ongoing assessment is occurring, however preliminary analysis suggests a glancing impact possible early on day 4 (20 Oct), but likely missing behind.

Onset of CH60/+ fast winds is expected on day 1 (17 Oct), later than originally forecast, but in line with the weak enhancement indicated in MOSWOC enlil. This currently suggests solar winds increasing on 17 Oct to around 450-500km/s. Given the positive polarity of the coronal hole, and the time of year, this is likely to be geoeffective, bringing the potential for G1 Minor Storm intervals albeit with low confidence. Any fast wind enhancement, coupled with any CME arrival, is expected to ease later day 2 onward, with winds easing back towards background. Any potential slight increase to solar winds from CH62/- is currently not expected until late day 4, (20 Oct) or more likely day 5 (21 Oct).

Mainly Quiet geomagnetic activity at first, but likely increasing to give a spell of Unsettled to Active with a chance G1 Minor Storm intervals day 1 and 2 (17-18 Oct) from CH fast winds and CME glances. These are both low confidence however. Activity easing back to mainly Quiet day 3 and 4 (19-20 Oct).

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	30	30	5	10
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
14/1337	Partial	Filament	NW	448 km/s	18/0900 UTC	Low confidence, glancing.
14/2152	Partial	Filament	NW	431 km/s	18/0900 UTC	Low confidence, glancing
16/1050	Partial	C7.5 of AR3467	NE	651 km/s	Early 20 Oct	Under review. Glancing impact/missing.

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Figure 2a: ENLIL and Ensemble. This shows the potential CME arrivals, including the slight glance later in the period from the CME which occurred on the 16 Oct.

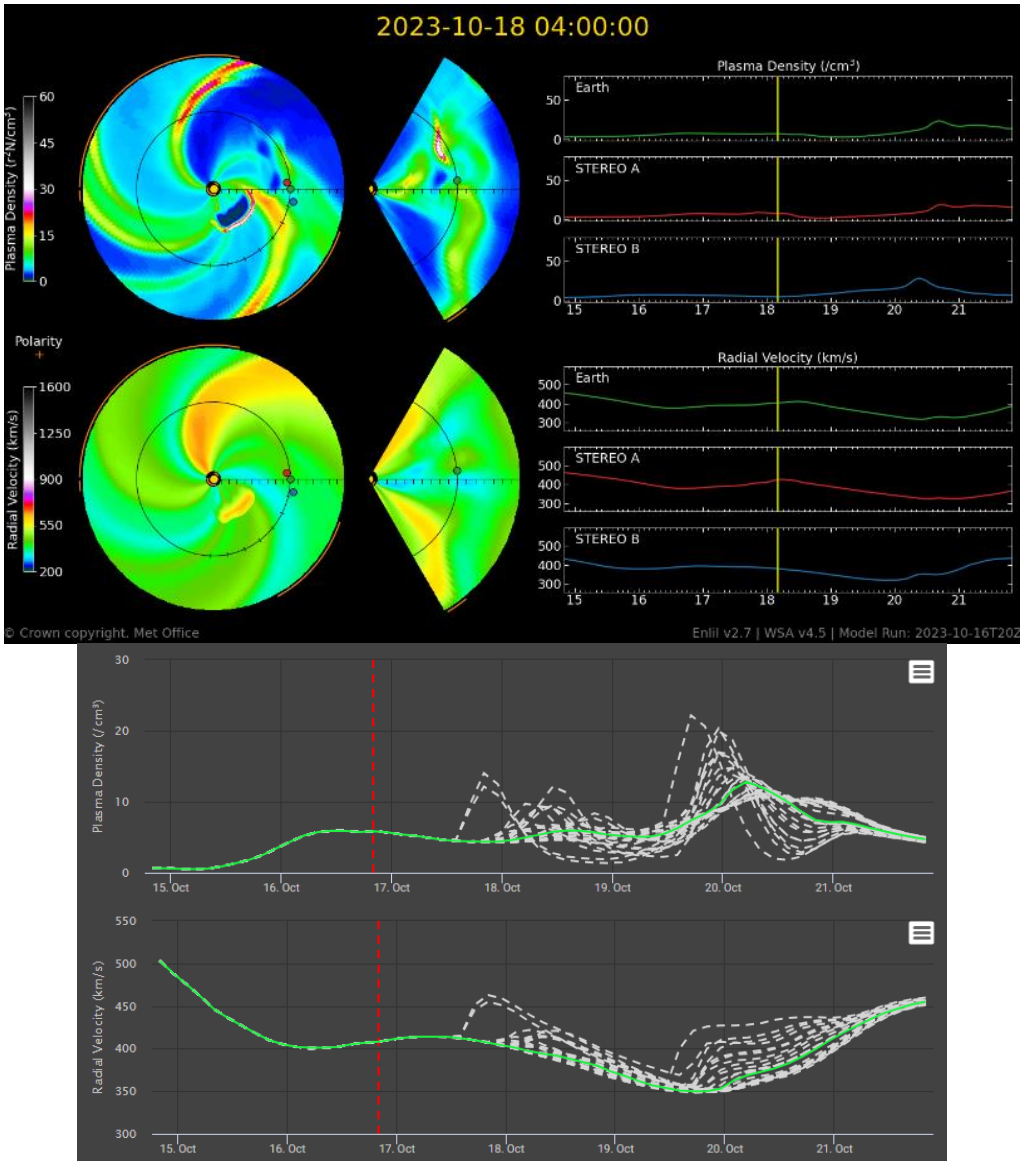
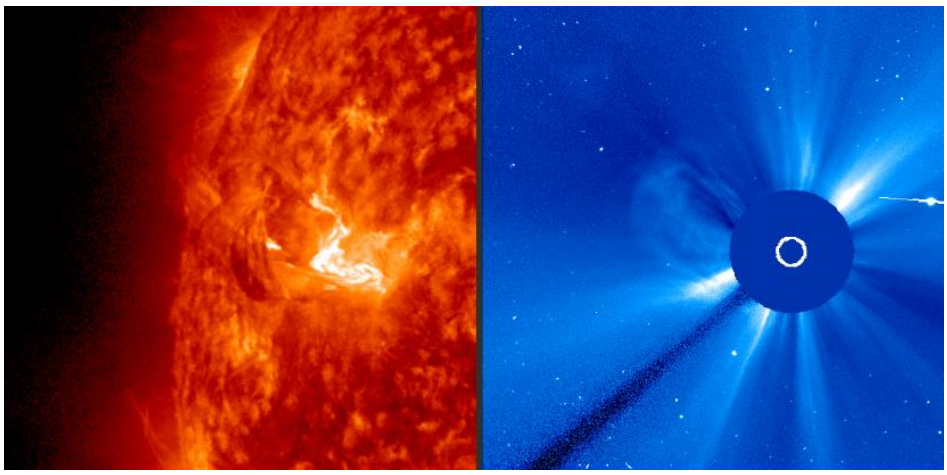


Figure 2b. SDO aia-304 (left) and SOHO cor3 (right) showing CME from Ex-3467



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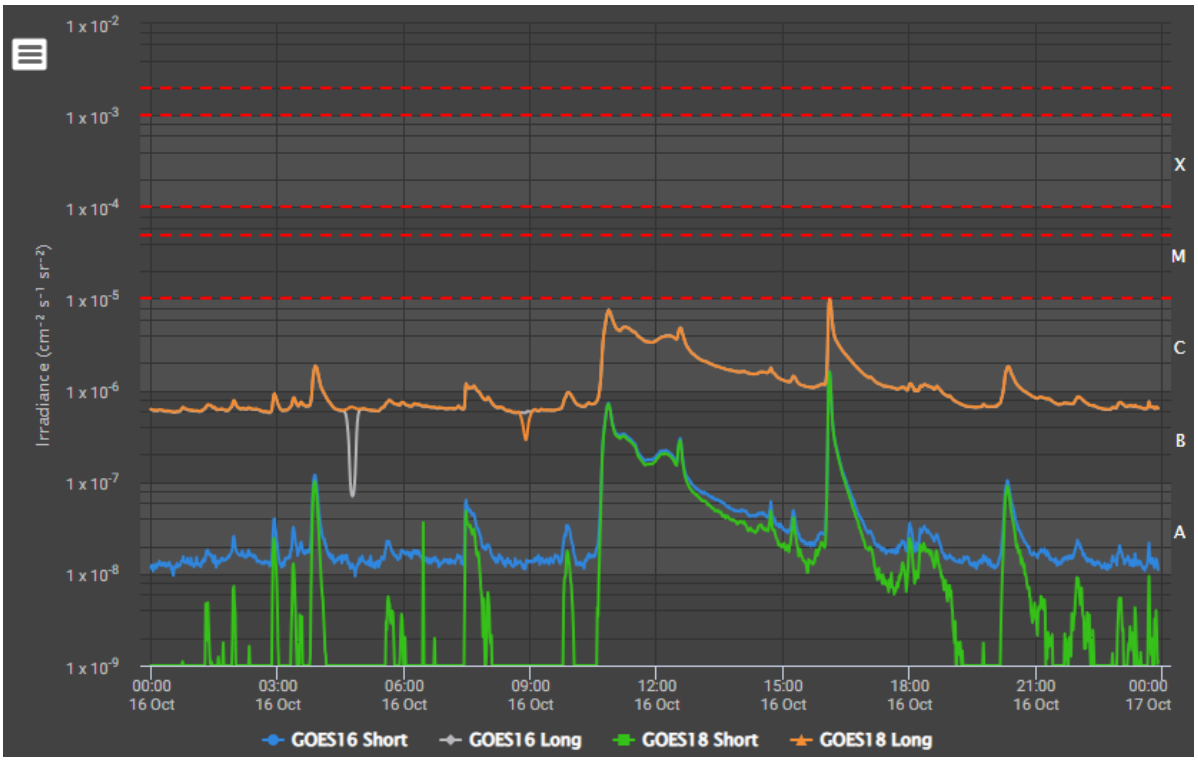
Radio Blackouts - X-Ray Flares:

Low activity is expected, with only a slight chance of M-flares. This risk increases through the period, due to the likelihood of further regions either developing or rotating onto the disc.

There are currently only six small and relatively simple sunspots on the disc. The most prominent remain AR3464 and AR3465, not far from the centre disc, although both of these have remained relatively stable. The most recent C-flares were observed from two emergent and unnumbered spot locations, however due to their limb locations they are both difficult to observe, consisting largely of faculae. A further C7.5 flare was observed from the ex-AR3467 in the northeast, however this subsequently faded. The other two regions include declining AR3466, which is now barely visible, and AR3468, a mature and stable unipolar spot near the southeast limb.

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 M Class	No	20	30	30	40
Very Active	R3 to R5 X Class	No	1	1	1	1

Figure 3: GOES16-18 X-ray flux



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Solar Radiation Storms - (High Energy Protons):

The high energy (greater than 10MeV) proton flux observed by GOES16 is most likely to persist at Background levels. Any increase to proton flux is unlikely, given the current visible disc sunspots.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ S1	No	1	1	1	1
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

Electron flux observed by GOES-16 at GEO are currently at background, however the Van Allen belts are likely to see electron population increase day 1 and day 2 (17-18 Oct). This is primarily due to the onset of fast winds of CH60/+ on day 1 (17 Oct), but with a more uncertain influence from any CME glance that occurs on day 2 (18 Oct). As solar wind pressure then eases the flux at GEO is likely to rise day 3 and day 4 (19-20 Oct), becoming more persistently Moderate with a chance of reaching High, mainly at diurnal peak periods. These enhancements are low confidence however, and it is possible that background electron flux will persist throughout.

The associated fluence is likely to remain below the Active threshold, however confidence decreases later in the period due to the potential for enhancement from CH60/+ fast wind and the CME impact. REFM is giving a good guidance to expected conditions in the absence of any enhancement, however this will become unreliable once any fast wind or CME arrival occurs.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ 2 MeV ≥ $1x10^8$	No	1	5	10	20
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

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